

Equipment and Supplies

Air medical escorts are responsible for many aspects of the air ambulance operation. Maintaining an appropriate and adequate inventory of equipment and supplies is an important part of the duties of the air medical crew. They must have a system in place to resupply after missions, perform routine maintenance on equipment, and retrieve equipment from receiving medical facilities. This chapter summarizes the equipment used on air medical transports. It also discusses some of the unique differences in using medical equipment during flight.

Learning Objectives

Upon completion of this chapter, the participant should be able to:

- ▶ Discuss six things to consider when using lights in the cabin during flight.
- ▶ State three oxygen safety precautions.
- ▶ Describe which intravenous (IV) container is preferred in an air medical environment.
- ▶ Describe three techniques to protect an IV from freezing in extreme cold.
- ▶ State how altitude affects retention balloons and how these effects can be minimized.

Equipment and Supplies

Historically, emergency medical service providers in Alaska have learned to work with minimal resources and to respond creatively to the challenges found in cold, rugged, and remote environments. Experienced air medical escorts recommend using the simplest gear adequate for a specific task.

Organizations will typically have commonly used supplies and equipment available. These organizations may not have more specialized or unusual equipment if routine duties do not require it. So the availability of specific pieces of air transport equipment and supplies varies between locations in Alaska. Prehospital transports, particularly when they originate in small villages or remote sites, depend primarily on equipment and supplies on hand. Transferring medical personnel need to notify the air medical crew if items they might need are not available at the site. The air medical crew may want to contact the personnel at the transferring facility to determine if specialized supplies or equipment are needed for a given flight.

Minimum and Special Needs

The State of Alaska has minimum equipment standards for certified air medical services, which initially were based upon recommendations from the National Highway Traffic Safety Administration (NHTSA) and the American Medical Association (AMA). Current recommendations are listed on the air ambulance certification application available on the state EMS Web site. Equipment carried on air medical flights may vary, depending upon the:

- Medical training levels of the escorts.
- Space available.
- Weight of the equipment.
- Capacity of a given aircraft.
- Cost of equipment.
- Organization's standing orders.

Air medical programs should select equipment based on the types of missions flown and the scope of practice of the crew. Some air medical transports may require specialized equipment to complete the mission. Special equipment may include:

- Infant transport incubator.
- Mechanical ventilator.
- Intra-aortic balloon pump or other portable cardiac assist device, etc.

Good preparation includes identifying if specialized equipment will be needed for a specific patient, and ensuring that appropriate adaptors and connecting devices are packed for flights.

Utilities

The range of utilities available in a given aircraft may affect the selection of air medical equipment used on a mission.

While the typical electrical supply in automobiles and ambulances is 12-volt direct current (12-V DC), light aircraft normally produce 24 to 48-V DC. Some aircraft have an “inverter” that converts DC power to 115-V alternating current (AC). The power delivered from an inverter differs from the 115-V AC power found in residential and institutional buildings, because it alternates at 400 Hz rather than at the 60 Hz common on the ground; power supplies may not operate correctly in an aircraft with an inverter. Inverters are not present in all aircraft, so the medical escort should ask the pilot about the types of power available on the aircraft.

New equipment should be tested in the medical aircraft before an actual transport to be sure it does not interfere with aircraft equipment. Before new equipment is used on flights, the pilot or air service must ensure compatibility with aircraft communication systems and instrumentation. This may involve a check ride by the FAA to test it. Electronic apparatus that interferes with aircraft systems should not be used during flights by an air medical service.

Battery life is important when selecting and using battery-power equipment. It is important to be able to estimate how long battery-operated equipment will be used on a given flight.

- Unexpected delays or changes in patient status that require higher power consumption can make it difficult to maintain important treatments to the destination.
- Ambient temperature also impacts battery life. In cold temperatures, battery life will be considerably shorter than at room temperature.

Lighting

Battery operated lanterns and flashlights are standard equipment used to improve onboard lighting. The following are things to consider when using flashlights:

- Extra batteries are compact and inexpensive. It is a good idea to have spare batteries available.
- Flashlights should not require an escort to hold them. There are a variety of lights with clips, ring attachments, or straps that can be mounted to direct their beams as needed.
- Headlamps can be useful if escorts are not wearing flight helmets.
- No flashlights should be held in the mouth. This puts escorts at increased risk for exposure to disease or injury.
- Flashlights can create problems for pilots. At night a sudden flash of bright light can temporarily impair pilots' night vision. Using a red, orange or green lens or lens cover will lessen this effect. If pilots are flying with night vision goggles, even a very small light can seriously impair their ability to see.

Escorts should discuss lighting procedures with pilots before a flight is requested.

Overhead lights should not be used on take-off and landing unless there is a division (door/curtain) between the patient and the pilot compartments.

Some smaller aircraft have on-board lighting. As a general rule, these lights should not be used when they are on the ground and the engines are off. The drain on the aircraft batteries can make it difficult for pilots to start the engines, this is especially true on cold days.

Oxygen

In addition to batteries, having an adequate supply of oxygen is crucial to the success of a medevac, especially if there are delays. Oxygen flows faster at altitude. Careful calculation of oxygen supply is critical. Ground time at both ends of the trip must be added into the supply calculation. Delays are common. Air medical escorts should be prepared for delays and have extra oxygen and other critical medications available.

Federal Aviation Administration (FAA) regulations, Section 91.211(a), on supplemental oxygen for *all* aircraft operations state:

“General. No person may operate a civil aircraft of U.S. registry—

- At cabin pressure altitudes above 12,500 feet (Mean Sea Level [MSL]) up to and including 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration;*
- At cabin pressure altitudes above 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen during the entire flight time at altitude; and*
- At cabin pressure altitudes above 15,000 feet (MSL) unless each occupant of the aircraft is provided with supplemental oxygen.”*

If the aircraft is being operated under Part 135, it also must comply with 135.157, which states:

“(1) At altitudes above 10,000 feet through 15,000 feet MSL, oxygen to at least 10 percent of the occupants of the aircraft, other than the pilots, for that part of the flight at those altitudes that is more than 30 minutes duration...”

The 10,000 feet discussed in this regulation refers to the altitude inside the cabin. Normally, pressurized aircraft keep their cabin pressures below 10,000 feet, which is why passengers on commercial airliners are not wearing oxygen masks under normal circumstances. In an unpressurized aircraft, the actual altitude and the cabin altitude are the same, so the passengers and the pilot may need to use supplemental oxygen when flying above certain altitudes.

Air medical aircraft may have two oxygen systems:

1. The emergency oxygen system which uses outlets and/or drop-down masks for the safety of the flight crew and passengers in the event of depressurization. The FAA requires this system for pressurized aircraft.
2. The medical oxygen system that is available for medevac patients. This oxygen is either brought onboard in portable oxygen tanks, or found in built-in oxygen tanks. The latter is more common on dedicated medevac aircraft.

Oxygen can be dangerous. Special precautions related to oxygen use during air medical flights include:

- Regularly scheduled inspection of all oxygen equipment by a designated person. Inspection is for the general condition of the tank and for its pressure. Crews also should check the oxygen level before taking off on a flight.
- Clearly labeling oxygen cylinders with “Oxygen–Oxidizer.”
- Ensuring that oxygen tanks are ready for use in the aircraft. It is best to have a regulator in place on every oxygen bottle before placing it on an aircraft. Securely fasten oxygen bottles to the airframe or stretcher during all phases of flight.
- No use of petroleum products or lubricants on oxygen equipment or in the area where oxygen is being used.
- No smoking while oxygen is in use.
- Informing the pilot before the flight if a patient will be on oxygen. The pilot has the ultimate authority to decide if oxygen is safe on a particular flight.
- Calculating the weight of the full oxygen cylinders as part of the total load on small aircraft. For example, a full E tank weighs approximately 15 pounds; this would be included in the total weight of cargo and passengers.
- Requesting oxygen for patients scheduled to be flown on larger commercial airlines at least 24–48 hours before flight. Airline regulations require that they supply oxygen cylinders.

Specifications of Oxygen Cylinders						
Type of Cylinder	Capacity			Height (inches)	Diameter	Weight (lbs.)
	(cu.ft)	(gallons)	(liters)			
D	12.7	95	360	20	4.25	10.25
E	22	165	620	29	4.25	15
W/M	40	299	1133	28	9	45
Q	80	598	2266	36	8	65
H	280	2093	7930	51	9.25	125

Airlines will not permit passengers to transport pressurized tanks containing gases.

Oxygen tanks must be purged before transport back to their community of origin. Commercial airlines may require a certificate from a compressed gas supplier to verify that tanks are empty before they will accept them as checked baggage.

Specific requirements need to be checked before trying to transport oxygen tanks.

Transferring and Retrieving Equipment

Surveys show that frequent loss of equipment during transport ranks high on the complaint lists of air medical providers. The severity of the problem varies between regions, but in the past it has been as much of a problem for some villages to retrieve equipment from community or regional hospitals as it has been for them to retrieve it from major hospital referral centers. Some medical supplies (e.g. scalpels, needles, etc.) are not permitted as carry-on luggage on commercial airlines due to increased security required by the FAA. These items may be checked on commercial jets or shipped back to communities (e.g. mail, cargo or freight carriers, etc.). The following suggestions can lessen retrieval of equipment problems:

- All reusable equipment should be clearly labeled. Be careful using initials, there may be many organizations with similar initials; medevac equipment is frequently sent far from the community of origin. An address and phone number should be included on the label.

- An adequate inventory of backup equipment should be maintained in case the transport provider cannot stand by at the receiving facility to recover everything that went with the patient on a given flight.
- Someone should be assigned to follow up on equipment return. It is helpful to have a contact list of the people who ship equipment back to outlying services.
- Trading for interchangeable items may be an option when equipment can't be retrieved on the spot. Some services allow this practice, others do not.

Equipment and Patient Care

The most significant effect the air medical environment has on patient care supplies and equipment is related to gas expansion at altitude. This section discusses management techniques to adapt to some of these conditions.

Intravenous Therapy

Pressure changes and acceleration forces during flight can make delivering consistent IV flow challenging. The following factors are helpful for escorts to remember when maintaining an IV during flight:

- IV flow rates usually are influenced by a combination of gravity and air pressure. These two forces cause IVs to flow. At ground level, in a hospital or clinic, these forces are static. During flights they constantly change.
- The changes in gravitational forces during take-off and landing has the most dramatic effects on IV function.
- Pressure changes during ascent and descent also influence IV function.
- Many short flights consist mostly of take-off, ascent, descent, and landing.

Other considerations that can affect the administration of fluids in the air medical environment include:

- Outside air temperature during loading and unloading.
- Inside air temperature during flight.
- Type of IV container (e.g. glass vs. plastic bottles).
- The viscosity of the fluid.
- IV catheter and drip chamber used.
- IV pump battery life.

An escort cannot let his or her attention wander from an IV line for more than a few minutes at a time.

Maximizing the height between the IV bottle and the patient's arm is the first step toward satisfactory fluid flow. Increases of only a vertical foot or two between the fluid container and IV site can double the achievable flow rate or, more importantly, restart flow in a line that has stopped.

Good cabin organization makes a flight more convenient and safe. Escorts can check aircraft for places to hang IV bags before loading their patients. There should be IV hangers available or a way to fashion one. Some materials that can be used to secure IV bags are listed below:

- Wire coat hangers or large heavy paper clips are excellent for rigging hooks. The hook can be bent closed after hanging so the bag can't slip off.
- Carabiners can be useful to secure items during flight.
- Tape can be used when there is nothing else available, but tape may fail, especially when using larger IV bags.

Fluid containers should be hung over a patient's feet. IV bags may swing during flight causing the tubing to bump the patient's face or head, which can become irritating. If the IV falls it is better that it land near the patient's feet.

IV Containers

IV administration systems are affected by barometric pressure changes. There are two classes of IV containers, soft plastic IV bags, and more rigid containers made of either rigid plastic or glass.

Soft plastic IV bags withstand changes in pressure best. Their flexibility allows them to collapse under atmospheric pressure as fluid drains out. This means that venting is not needed. Bags work properly with unvented drip sets.

IV pressure infusion devices or an extra blood pressure cuff wrapped around the IV bag increase the external pressure on the bag. This allows IVs to flow, even when there is little distance between the patient and the IV bag.

Expelling all the air from the bag before hanging it will decrease the chance of air getting to the patient. Securing the bag to reduce swinging can also minimize air entering the IV line.

Rigid containers (glass and hard plastic bottles):

- Retain their shape; they cannot collapse as IV fluid leaves the container.
- Will not flow due to changes in pressure unless used with vented IV tubing.
- Are harder to store.
- Are more prone to breakage.
- May cause pain if they fall on the patient.

Glass bottles must be vented for air medical use. Without vents they can shatter at altitude due to the gas expansion in the bottle. When glass bottles with integral air vents are the only option, the entire bottle should be taped with heavy cloth tape to prevent a scatter of glass shards in the event the bottle breaks.

Tubing for IVs

IV tubing with rigid metering chambers (e.g. Volutrol tubing) does not work as well in flight as standard tubing, even when vented. Pressure changes during ascent, or a rapid decompression, can increase the drip rate and force air into the line or fluid out through the vent. Pliable, unvented metering chambers are preferable in flight.

The use of IV pumps during transport is useful when volume delivery considerations are important (e.g. IV drip medications, pediatric patients). There are several types of IV pumps that work well in flight.

The following are possible complications from IV infusion:

- Blood back-flow into the tubing.
- Spontaneous changes in drip rate.
- Inability to make the IV flow.
- Air bubbles in the line.

Venting Methods

Sometimes venting an IV bottle is necessary. While most places in Alaska have soft IV bags, some medications (e.g. nitroglycerin, insulin) should be administered in glass bottles. If vented IV tubing is not available and a glass bottle must be used, the air medical escorts should use the technique below:

1. Insert a sterile 18-gauge needle through the bottle cap into the lumen (hollow center) of the rod.
2. Remove the cap from the air vent on the drip set.
3. Insert a sterile 2 or 3 cc syringe into the vent.
4. Secure the syringe into the vent by running a strip of tape over the plunger and all the way around the neck of the IV bottle. As the air in the bottle expands it will leave the bottle through the needle inserted into the air rod. The syringe will act as a plug, held in place by the tape. It will prevent fluid from pouring out of the bottle.

If a glass bottle with an unvented drip set is used, only step 1 above needs to be done. Adapter pieces to turn non-vented tubing into vented tubing are also available.

When using the recommended pliable metering set, a clamp between that chamber and the fluid container (or drip set immediately above) assures that neither air nor more fluid enters to disrupt its collapse.

General Hints and Reminders

- IV pumps (e.g. IVAC[®], IMED[®], Valleylab[™], etc.) can reduce pressure and gravity problems. If they are available, escorts are encouraged to become familiar with them. Not all pumps work well in aircraft due to vibrations or lack of space. Some pumps may not operate on the alternating current generated by an aircraft inverter, so battery life can be a problem. Air medical escorts should check the manufacturers' recommendations. They may also want to use the pump on a stable patient, and monitor the pump and the patient closely, before relying on it in critical situations.
- An in-line rate controller (e.g. Dial-A-Flow[™], etc.) can be used to prevent increases in fluid drip rates with changes in altitude or G forces. These devices will not prevent decreases in flow rates, however.
- A pressure infusion bag or a blood pressure cuff can help keep an IV line running, especially when the IV bag is close in height to the IV site. These may work on the semi-rigid IV bottles, but escorts will need to watch these lines especially carefully. IV pressure infusion bags provide more equalized pressure over the IV bag or bottle than a standard BP cuff.
- The drip chamber should stay at least half-full of fluid to minimize the introduction of air bubbles into the tubing.

Cold Weather and IV Therapy

Another challenge in air medical transports in Alaska, especially in the winter, is keeping IV lines and fluids from freezing. IV lines can freeze during transfers between ambulances and aircraft, or during transport to the aircraft when warm ambulances are not available. IV tubing is so thin that the fluid in the tubing will freeze almost instantly when exposed to very cold temperatures. There are a number of techniques that can be used to prevent this:

- Use a saline lock, rather than an IV line, if fluid administration is not required or can be delayed until the patient is securely loaded into the aircraft. An IV line can be hung once the aircraft is sealed and heaters are on.
- Place the IV under the patient or in a pressure bag and tuck it under the blankets. This system works well as long as the entire tubing stays under the blankets. The pressure infuser helps maintain IV flow. This precaution is vital for even short exposures to cold outdoor temperatures.

- Insulation of the IV system. There are a number of commercially available IV warmers that use hot packs alongside the IV bag. A homemade system may include the placement of hot pads next to IV bottles or at the top of the IV tubing. Hot packs must **not** be near patients. Hot fluid can cause serious burns to veins and the patient's skin. A homemade system can be insulated with Kerlex or Ace wraps.

When an aircraft cabin is cold, IV containers and tubing can be placed under jackets, blankets or near warm bodies. If IVs are placed inside an escort's coat to maintain heat, it may be more difficult to keep the tubing from freezing as some portion of the tube may be exposed to the ambient air.

Cold Weather and Oxygen Devices

Oxygen devices also can be affected by cold weather. Bag-valve-mask (BVM) devices used in Alaska must be flexible enough to re-expand in the cold. Some of the hard plastic bags get stiff and do not re-inflate well. BVMs should be tested in the cold before they are placed in service on an air medical flight.

If the oxygen gasket (O-ring) between the oxygen regulator and the oxygen tank is made from a hard plastic, it may become brittle in the cold. This can cause cracking and allow oxygen to leak from the tank. Nothing can be used to re-seal this type of leak. The O-ring needs to be replaced, but changing regulators or replacing the O-ring may not be possible in flight. It is wise to carry a few extra O-rings with air medical supplies as they can be used while on the scene of the incident or at a clinic. **Attempting to seal these leaks with petroleum products can cause a fire. Never use petroleum products around oxygen sources.**

Chest Tubes

Chest tubes are used to treat pneumothorax, hemothorax, or empyema. When the intrapleural pressure in the chest is altered by excess air and/or fluid, it can cause lung collapse. Chest tubes are inserted into the intrapleural space to allow drainage of this excess air/fluid. This allows the lungs to re-expand, promoting improved gas exchange.

Chest tubes are inserted into the intrapleural space. Rubber tubing connects the chest tube to either a closed gravity-drainage system or to a closed suction circuit. Gravity drainage systems should be kept lower than the patient.

Heimlich valves are used to prevent backflow of fluid and air into the patient if the tubing becomes disconnected. They are a one-way valve that is placed between the chest tube and the drainage tubing. Complications that can arise from using chest tubes include:

- Chest tubes can come out. Patients then have an open chest wound. If so, the wound should be covered with an occlusive dressing at the peak of patient inspiration. Monitor very closely for the development of a tension pneumothorax.
- Chest tubes can become disconnected. If this occurs, the tubing must be re-connected and the patient monitored for development of a tension pneumothorax. If the patient develops a tension pneumothorax, it must be treated immediately.

Methods to reduce complications from chest tubes include:

- Tape all connections securely. Put extra tape around the insertion site to prevent the chest tube from disconnecting or pulling out of the chest.
- Package patients so tubing will not be kinked.
- Keep drainage systems (e.g., Pleur-Evac®) upright.
- Have a hemostat available to clamp tubing if it becomes disconnected.
- Place the patient in a semi-Fowlers position; it may help remove air from the chest.
- A high-Fowlers position may aid in fluid drainage from the chest cavity.

Nasogastric (NG) or Orogastric (OG) Tubes

NG and OG tubes are used to remove air, blood, body fluids, or medications from the stomach.

They are placed through the nose or the mouth into the stomach, then connected to suction, or they can be allowed to drain by gravity into a container. Intermittent suction is preferred.

If the tube is inserted incorrectly, the following complications can result:

- If the NG or OG tube is inserted into the trachea, the patient may cough violently or be unable to speak. The tube must be removed immediately in this situation.
- If the tube is not inserted deeply enough, it remains in the esophagus instead of the stomach. Tube placement must be checked after insertion and advanced to the proper depth.

There are steps escorts should follow to avoid complications when using NG or OG tubes:

- Always check the placement of NG or OG tubes.
- Use an OG tube instead of an NG tube in patients with facial or head injuries. This decreases the risk of the tube going through the cribriform plate into the brain.
- Some patients have nasal obstructions. It may help to check to ensure a nostril is patent before starting to insert an NG tube. If one nostril seems to be obstructed, try the more patent nostril first.
- If an NG tube is too flexible, cooling the end by placing it in ice for a few minutes may make insertion easier.
- Positioning the patient with his or her head elevated and the neck flexed may also make insertion easier.

Positive End Expiratory Pressure (PEEP)

Valves

PEEP valves are used to keep a small amount of pressure in the alveoli and small airways to prevent collapse. The theory is that this will assist with ventilation of patients with conditions such as Adult Respiratory Distress Syndrome (ARDS), near drowning, or pneumonia.

PEEP valves fit into most bag-valve-mask (BVM) systems. Some of them have adapters to make them interchangeable with several brands

of BVM. PEEP valves designed for the specific BVM being used is best. Adjustable peep valves that provide between 5 and 20 cm of pressure are preferred. Both disposable and reusable varieties are available.

Patients who require PEEP should be reassessed frequently.

End-Tidal Carbon Dioxide (CO₂) Detector

An end-tidal CO₂ detector is a device that measures the concentration of exhaled CO₂. When CO₂ is present in exhaled air, the tube is properly placed in the trachea. If the patient has spontaneous circulation, lack of exhaled CO₂ means that the tube is in the esophagus. Leaving a monitoring device in place during transport helps the escort recognize if the endotracheal (ET) tube becomes dislodged. The American Heart Association recommends that end-tidal monitors be used as a secondary confirmation of ET tube placement.

The two types of end-tidal CO₂ detectors are the colorimetric CO₂ detector, and electronic monitors.

Colorimetric CO₂ detectors are disposable devices that use a chemical sensitive to carbon dioxide to indicate if CO₂ is present. The detector is placed on the end of the ET tube. The bag-valve bag or ventilator is attached to the detector. The colorimetric device has a window with paper behind it. The paper is purple when the package is opened, and changes to yellow in the presence of carbon dioxide. Give at least six breaths to the patient, then analyze the color of the paper on exhalation. These detectors can be left in place for up to two hours. They are available in both adult and pediatric sizes.

Electronic monitors determine the presence of carbon dioxide in exhaled air using an infrared analyzer to measure the percentage of carbon dioxide during respiration. They indicate the CO₂ level numerically (capnometry), as a waveform (capnography), or both ways. They can be left in place for the duration of the flight.

Some limitations to monitoring end tidal CO₂ levels include:

- Carbon dioxide production may not be great enough to be detected in low flow states (e.g. with cardiopulmonary arrest).
- The device may not work if it becomes wet from medications or vomiting.

Color Changes Seen in Colorimetric CO₂ Detectors During Exhalation

Yellow	Tube is correctly placed in trachea.
Tan	Re-evaluate tube placement.
Purple	ET tube needs to be replaced.

- Using the correct size device is important—devices designed for children have a smaller “dead-space.”

Ventilators

Ventilators are used to breathe for intubated patients. Many makes and models are available. Most transport ventilators require connection to an oxygen source for operation, but some ventilators have a built-in air compressor and can operate without an oxygen source. They deliver only 21% oxygen, the same as room air, when used this way.

Escorts need to choose a respiratory rate and tidal volume to deliver to each patient. The respiratory rate must be based on the patient's condition and must be within the escorts' medical guidelines.

Transport ventilators generally have a battery. They also should have a charging cord that can be plugged into the aircraft inverter if the aircraft is so equipped.

Complications from using ventilators can include:

- Pneumothorax, which can be caused by over distension and rupture of the alveola.
- Hypotension, which can result from air in the lungs increasing the pressure within the thorax. This increased intrathoracic pressure can lead to decreased venous return of blood to the heart and reduced cardiac output.

Air medical escorts can take the following steps to minimize complications associated with ventilation:

- Assess chest rise, breath sounds, and vital signs frequently to assure that the ET tube is positioned properly.
- Calculate the rate of oxygen consumption and monitor the oxygen status carefully. Ventilators can deplete the oxygen supply quickly. Oxygen leaking from the ventilator system may be difficult to detect in the aircraft due to the noise level.
- Revert immediately to manual ventilation in the event of device failure, hypoxia, or other complication.

i-STAT® Analyzer

i-STAT® Analyzers are portable clinical blood analyzers used to determine specific lab values of substances such as electrolytes, glucose and arterial blood gases. Only a few drops of blood are needed for each test. Lab results are displayed digitally and are stored on a computer chip that can be downloaded onto a computer after the flight.

The use of the i-STAT® is regulated by the federal Clinical Laboratory Improvement Act (CLIA) and OSHA. The regulations require agencies using the i-STAT® to be affiliated with a laboratory that can assure quality control. This can be a limitation for some air medical services. Another limitation of i-STAT® Analyzers is the high cost of the cartridges, and that a new cartridge must be used for each test.

Retention Balloons

Retention balloons are air-filled balloons used to keep a device inside a patient (e.g. Foley catheter, ET tube). These balloons use low pressure to prevent necrosis of tissue under the balloon. Any device with a retention balloon should be monitored during flight for the build-up of pressure in its system. The practice of filling retention balloons with saline is no longer encouraged.

Suction Devices

Suction devices are essential on medevac flights. Motion and turbulence, combined with pain and anxiety, can make patients more susceptible to vomiting. If patients are unable to roll to the side when they vomit, they are more likely to aspirate.

Some aircraft have built-in suction devices, while others depend on portable units. Battery operated suction devices have limited operation time. In cold temperatures, battery life is shortened considerably.

Having manual suction devices as a backup is a must. In situations where limited space is a concern, the manual device may be the only one carried to the scene of the incident. V-Vacs™ and other manual suction units can be effective. Most devices have disposable collection chambers for easy cleanup.

Medications

Air medical escorts should know the indications, contraindications, side effects, actions and dosages for all drugs they routinely carry and administer. Additionally, they need to research information about new drugs before using them in flight. Some services choose to include a drug reference book in their standard flight gear.

Medical providers must know what drugs are included in the scope of practice at the level for which they are credentialed. If a Medical Director for EMT-Is, EMT-IIIs, or EMT-IIIs wants to add to the scope of practice for an individual, he or she must comply with Alaska EMS Regulation 7 AAC 26.670.

Medications Causing Problems with Oxygenation

In moderate doses, aspirin and sulfanilamide may make a patient more susceptible to hypoxia. Patients who are evacuated as a result of an aspirin overdose are more prone to hypoxia.

Dressing Changes

When transporting patients with draining wounds, dressing changes should be done before or after transfer. The aircraft environment may not be as clean as a hospital, particularly if the aircraft is used for non-medical flights. Soiled dressings need to be placed in a red bag and disposed of in an appropriate manner. If dressings are soaked through, additional dressings should be used to reinforce them. If necessary, that reinforcement can be removed and fresh reinforcements applied, but open wounds should not be exposed.

Pre-filled Syringes

Many injectable advanced life support drugs and pain medications come in pre-filled syringes. These syringes often contain an air bubble that is expelled just before injecting the drug. Since air expands with increased altitude, removing the air when stocking drug kits may be better than leaving it in the syringe. Theoretically, medications stored

in sealed glass systems could break at altitude, but the authors of this text know of no instances of this happening.

Some schedule II narcotics and other medications such as epinephrine 1:1,000 are packaged in pre-filled tubex syringes. The small rubber seal at the end of the syringe can be forced out the back of the syringe, due to changes in altitude, allowing the medications to leak from the back of the syringe. This situation can create a problem when a patient needs the particular drug that was in the now empty tubex syringe. It also can cause problems with missing narcotics, which must be tracked by law. This type of packaging is best avoided. If tubex syringes are used, they should be checked before every flight. Replace any tybex syringes that have leaked.

Patient Warmth

Keeping patients warm in flight can be a challenge, particularly in smaller aircraft with minimal heating systems. Three common insulating covers used in air medical transports are:

- Commercially available air medical blanket systems (e.g. Dr. Down[®], 'Life' Blanket, etc.).
- Sleeping bags are used by some services. Bags that are easily washed or have disposable waterproof linings are easier to maintain.
- Extra blankets are essential, especially in smaller planes, where patients are positioned close to the fuselage walls. Cold is easily conducted through the walls, making it difficult to keep patients warm without an insulating barrier.

Recommended Infection Control Supplies

While space can be a concern in small aircraft used for air medical operations, it is important to include all essential medical equipment and supplies, including appropriate infection control supplies. It is recommended that the following items be included on all flights:

- Disposable gloves (various sizes).
- Waterless, anti-microbial hand cleaner.

- Disposable gowns.
- Regular surgical masks for patients.
- N95 masks for medical personnel and flight crew when transporting patients with suspected tuberculosis, SARS, or other infectious airborne diseases.
- Eye protection.
- Small portable sharps containers.
- Isolation trash bags.
- Regular trash bags.
- Disinfectant solutions. It is important to check with the aircraft manufacturer before using chemicals or solvents in aircraft to be sure that they will not damage aircraft parts.

Summary

The equipment and supplies used in air medical transports are similar to, and in some cases, the same as those used in ground ambulances. Air medical service equipment may use different power systems (e.g. inverters) and may need smaller and lighter equipment for some tasks. The effects of altitude and flying must be taken into consideration when using standard EMS equipment in the air. Questions to consider when planning for air medical transports include:

- Will the equipment be affected by altitude?
- Will the equipment impact patient comfort and well-being?

When planning for air medical transport, it may be useful to identify equipment already being used in an area. Using similar equipment and supplies on air medical transports makes transferring patients from these sites easier if you have compatible supplies (e.g. IV tubing, ventilator tubing, etc.).

It is critical that escorts know the limitations and advantages of their equipment, supplies and the aircraft they are using.

Notes
